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EUROPEAN PATENT APPLICATION

21 Application number: 88300329.5

51 Int. CL⁴: **F 41 G 7/00**

F 41 G 3/00, F 41 G 5/08

22 Date of filing: 15.01.88

30 Priority: 16.01.87 US 3737

43 Date of publication of application:
27.07.88 Bulletin 88/30

84 Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

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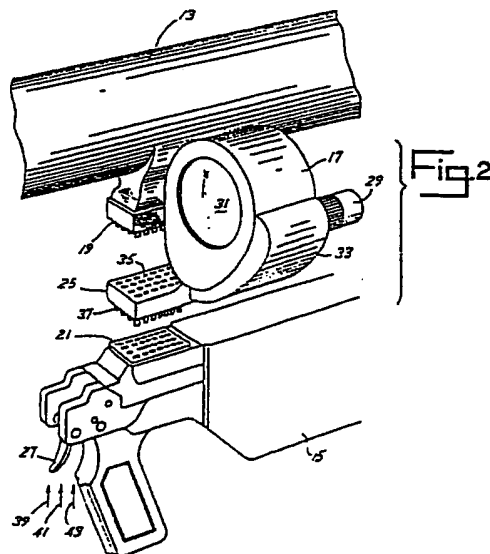
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54 **Missile aiming sight.**

57 A missile aiming sight 17 for use in a man-portable missile launching system which includes an adaptor section 25 for connection between a conventional grip-stock 15 and missile launching tube 13. The aiming sight monitors the electrical communication between the launching tube and grip-stock in order to drive a pair of sighting reticles. The reticles are positioned in the image plane of a telescopic viewing system for providing a visual indication by the intersection of the reticles as to the point of regard of the missile. A separate visual indicator is positioned at the centre of the image plane to indicate that the missile electronics has locked on to a target. Additional indication is provided in the image plane to indicate out-of-tolerance and other sighting conditions to alert the operator to restart the missile firing process.



As shown in Fig. 2, launch tube 13 is cylindrical in shape and includes a male plug element 19 extending from its outer surface. Element 19 is manufactured in a form to be plug secured directly into a female plug receptacle 21 of grip-stock 15. In ordinary use, a missile launch operator 23 (Fig. 1) connects plug receptacle 21 of the grip-stock into plug element 19 of the tube. The tube is next placed on the operator's shoulder for firing in a shotgun fashion, similar to that shown in Fig. 1.

As shown in Fig. 2, sight 17 includes an adaptor section 25 for connection between grip-stock 15 and launch tube 13. The particular physical form of adaptor section 25 may be of any desired shape or size and may be constructed with the physical shape of the particular missile tube and grip-stock in mind. As will be understood, the drawing of Fig. 2 is used merely as an aid to this description and does not attempt to show the entire casing structure of any particular launch tube 13 or grip-stock 15.

Grip-stock 15 includes a trigger 27 which is manually actuable by the operator for controlling the missile launch sequence of the system. After launching of the missile, the grip-stock is removed from the tube and the used tube is discarded. The grip-stock is then used with another launching tube.

As shown in Fig. 2 missile aiming sight 17 includes an eyepiece 29 and an objective lens 31 through which the launch operator views a target to be fired upon, as shown generally in Fig. 1. Between eyepiece 29 and objective lens 31 is an image erection system which is described hereinafter in reference to Fig. 3. A casing 33 houses the optical system, and an electronic system (described hereinafter), protecting the same from the environment. The particular configuration of the casing may be of any desired shape.

Adaptor section 25 provides an area for interposing the sight between tube 13 and grip-stock 15. A female receptacle 35 receives plug element 19 of the launch tube and a plug element 37 engages into receptacle 21 of the grip-stock. The grip-stock and launch tube are electrically and mechanically connected through the adaptor section as though the aiming sight was not interposed between the grip-stock and tube. The electrical communications between the grip-stock and the tube are monitored by the aiming sight, as described more fully hereinafter.

As will be understood, the manner in which the particular grip-stock communicates with the particular launch tube being interfaced may dictate the structure of adaptor section 25. The invention is not limited to a particular grip-stock and launch tube, as will be understood from the claims. The only requirement is that the aiming sight electronics have access to the missile tracking head signals, described hereinafter.

The missile within tube 13 is a heat seeking missile and includes an electronic circuit which controls its launch and guides the missile in response to heat radiation from the target. The electronic circuit includes a missile tracking head formed of a gyro stabilized detector which may be caged or uncaged. In its uncaged state, the detector is free to turn

within gimbels and allows the tracking head to track the target. The electronic circuit generates a missile tracking head signal which is an electrical signal representative of the point of regard of the missile, i.e., representative of the relative direction in which the circuit will guide the missile. Such circuits are conventional and understood by a person of ordinary skill in this art.

Trigger 27 is movable by the operator to one of three different positions, generally indicated by reference numerals 39, 41, 43. Trigger 27 is normally biased to a first position 39 in which the system is in a SENSING mode. In the SENSING mode, the gyro stabilized detector remains caged. The detector locates a "hot" target by being pointed in various directions by the operator until the detector locates a source emitting a large quantity of IR rays. When the missile's detector finds a large heat source (commonly referred to as "locking-on" a target), a lock-on signal is generated by the missile's electronic circuit. The lock-on signal is an audio frequency signal which is transmitted to a speaker (not shown) located in the grip-stock. Sound is generated from the speaker to alert the operator that a target has been located and that the trigger may be moved to its second position 41 to uncage the gyro stabilized detector and begin its tracking of the target.

When the operator moves the trigger to the second position 41, the missile is uncaged and the missile's tracking system is activated.

The operator, of course, continues to move the missile tube with his arms, "aiming" or "pointing" the tube at the target. The missile tube has a point of regard which is defined by the axis of the tube. Using the sight 17 the operator is better able to point the axis of the tube with respect to the target.

As will be understood, there may be a number of heat sources in the air in the general direction at which the operator is "pointing" the tube. The operator may not know which of the specific heat sources the missile has actually locked onto.

When the operator moves the trigger to the third position 43, the missile is launched from tube 13. As will be understood, the missile operator should aim the tube ahead of the moving target to assure a more likely chance for a hit. This is true even though the missile has its own heat seeking guidance system.

Referring to Fig. 3, an optical telescopic system 45 is formed of eyepiece 27, an image erection system 47, and an achromatic objective lens 29. Erection system 47 is commonly known as a "second type", having two mirrors 49, 51 and one dual reflection prism 53. Where weight is important, prism 53 may be replaced by mirrors. Any form of image erection may be employed either reflecting or refracting.

Light entering objective lens 29 along a pathway 55 is rotated by erection system 47 forming an image at an image plane 57 located in front of eyepiece 27. A window 59 formed of a plate of glass may be positioned in front of objective lens 29 and serves to protect the objective lens. Also, window 59 is tilted with respect to lens 29 for reducing glint (optical signature) across the lens.

conductors 99, 101. The signals on conductors 99, 101 are D. C. signals between + and -5 volts.

A summing amplifier circuit 91 algebraically adds the X signals of conductors 83, 99 to produce an X signal along a conductor 103 and adds the Y signals of conductors 85, 101 to produce a Y signal along a conductor 105. The X and Y signals on conductors 103, 105 provide an indication of required missile lead. That is, the missile lead represents the lead in front of the target at which the tube should be pointed ahead of the target to give a more likely chance for successful "hit" or engagement. Thus, lead computer 97 serves to adjust the position of reticles 67, 69 such that the operator's positioning of the tube to place the intersection point of the reticle directly on the target in actuality points the tube ahead of the target.

Control circuit 71 also includes an elevation or horizon sensor 94 that is used to generate a super-elevation signal along a conductor 96 to summing amplifier 91. The super-elevation signal affects the horizontal reticle indicator 67 only. The super-elevation signal is used to elevate the missile tube above what would otherwise be the normal line of sight prior to launch so as to compensate for gravity induced drop. The particular angle of elevation of the tube with respect to the horizon is monitored by sensor 94 for generating the super-elevation signal of a D. C. voltage level having a magnitude dependent on tube elevation.

As will suggest itself, the rate synthesizer, lead computer and elevation sensor need not be used, and the operator will be instructed to aim ahead of and above the moving target for a more likely chance of an engagement. In such a case the X and Y signals from demodulator 81 are fed directly to galvanometers 87, 89.

The X and Y signals on conductors 103, 105 are also fed along conductors 107, 109 to a fire inhibit circuit 111. Fire inhibit circuit 111 uses the X and Y signals on conductors 107, 109 to determine the probability of a successful engagement. Inhibit circuit 111 decides from the X and Y signals whether the dynamic situation exceeds a desired limit or whether the tracking head signal is erratic and random.

The tracking head signal becomes erratic and random if lock-on is lost. Inhibit circuit 111 monitors the X and Y signals for this, and responds by generating an inhibit signal along a conductor 113.

Also, the inhibit circuit serves as a window detector for determining whether the missile point of regard (x position, y position) is beyond the edge of the field of view 60 (Fig. 4) of the sight. The field of view is, of course, a constant (X position, Y position). The missile point of regard is compared against certain X and Y limits to determine whether the tube is pointed correctly to make an engagement. This encourages the operator to keep the viewed target near the center of the field of view as seen through the sight (except as may be directed by lead or super-elevation circuitry discussed above, as will be understood).

Fire inhibit circuit 97 generates an inhibit signal along conductor 113 to inhibit the launching of the

missile by preventing movement of the trigger 27 to its third position. Trigger 27 includes a mechanical lever arm which cooperates mechanically with launch tube 13 to launch the missile. The lever arm is mechanically coupled through the adaptor section 25 of the sight to perform this function. A solenoid housed in the adaptor section is driven by the inhibit signal on conductor 113 in order to mechanically block the trigger to prevent the trigger from going into its third position.

Fire inhibit circuit 111 also generates a signal along a conductor 115 which passes through gate element 82 and onto output drive conductor 84 to LED indicator 65. The fire inhibit signal on conductor 115 has a particular waveform which causes LED 65 to flash rapidly as an out-of-tolerance warning indication to the operator.

A built-in-test (BIT) circuit 121 is provided as a test device to assure the operator that the aiming sight is functioning properly. An external test switch (not shown) on the sight may be actuated to run the test. BIT circuit 121 includes a stored program for generating a predetermined pattern of X signals through a switch 123 and onto a conductor 125 and predetermined Y signals through a switch 127 and onto a conductor 129. The X and Y signals from BIT circuit 121 drive reticles 69, 67 through a repetitive predetermined pattern or sequence to reassure the operator that the sight will function correctly during an engagement. Should the reticles not sequence, the operator should replace electronic control circuit 71.

The electronic control circuit 71 is powered by a battery power supply (not shown). The power supply consists of dry cell batteries. A power conditioning circuit accepts the battery supply output, and by means of a conventional DC-to-DC switching converter, produces various power levels required for circuit operation. The power conditioning circuit may include additional circuitry which monitors battery condition and indicates battery status to the operator. Alternatively, the system may be powered by the missile battery system and internal batteries of the sight being used only for the BIT system.

To operate the system, the grip-stock, aiming sight and missile tube are connected together by the operator by simple plugging the components into one another. A battery (not shown) is then connected to the missile system to turn it on.

The trigger will be in its first position and the missile electronics will enter its SENSING mode to seek an IR source. The operator will view through the sight as he fans the tube across the sky looking for an appropriate target. When the missile detector locks onto a heat source in the general direction of the point of regard on the missile tube, the operator will hear the audible tone from the grip-stock speaker and will see the LED display light up through the sight. Fig. 6, 7 and 8 are examples of what the operator will see through the sight.

If the target is appropriate, the operator will move the trigger to the second position to uncage the gyro stabilized detector. The missile tracking head will enter its TRACKING mode to track the target to which it is locked on. The point of regard signal from

guidance system searches for and locks on to a heat source of a particular heat magnitude and generates a second electrical signal indicative of lock-on of a heat source; and wherein the missile aiming sight includes lock-on indicator means responsive to the second electrical signal generated by the electronic control/guidance system, for alerting the operator that lock-on of a heat source has occurred.

15. A missile aiming sight according to Claim 14 wherein said lock-on indicator means includes a visual indicator in said image plane of said telescopic viewing system.

16. A missile aiming sight according to Claim 15 wherein said visual indicator is located at the center of said view area.

17. A missile aiming sight according to Claim 16 wherein said visual indicator is a light emitting diode.

18. A missile aiming sight according to any preceding claim wherein said reticle control means includes pattern generator means manually actuable by the operator for generating a pattern electrical signal, said reticle control means moving said reticle in a pre-determined pattern within said image plane in response to said pattern electrical signal generated by said pattern generator means.

19. A missile aiming sight according to any preceding claim and further including visual stadia indicator means located in said image plane for visual determination of target in-range condition.

20. A man-portable missile launching system comprising:

a heat seeking missile;

a launch tube pointable by an operator with respect to a target and along the tube's point of regard;

control/guidance means including tracking means for generating an electrical signal indicative of missile tracking head point of regard;

a grip-stock including trigger means manually actuable by an operator for launching the missile;

adaptor means connectable to said missile launching system for monitoring said electrical signal generated by said electronic guidance system;

a telescopic viewing system for generating a magnified image of a target to be fired upon, said telescopic viewing system having a view area fixed with respect to the point of regard of said launch tube and having an image plane wherein a field of view appears;

a reticle movable in said image plane for visually displaying an indication to the operator;

a reticle control means responsive to said electrical signal for moving said reticle within said image plane in accordance with the missile tracking head point of regard indicated by said electrical signal.

21. A man-portable launching system according to Claim 20 wherein said control/guidance means searches for and locks onto a heat

source of a particular heat magnitude and wherein said tracking means is actuable by an operator via said grip-stock for tracking a heat source locked onto by said control/guidance means.

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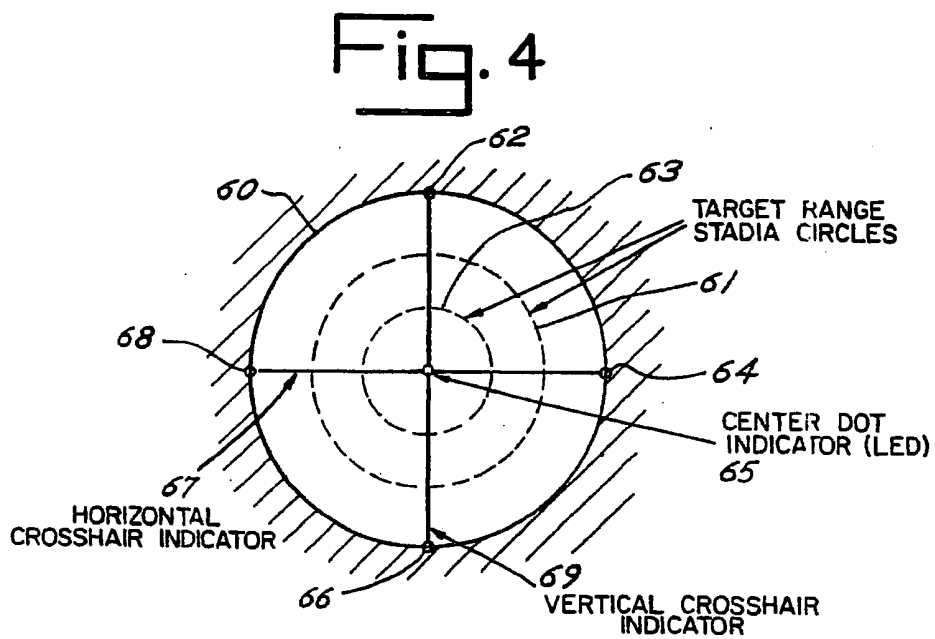
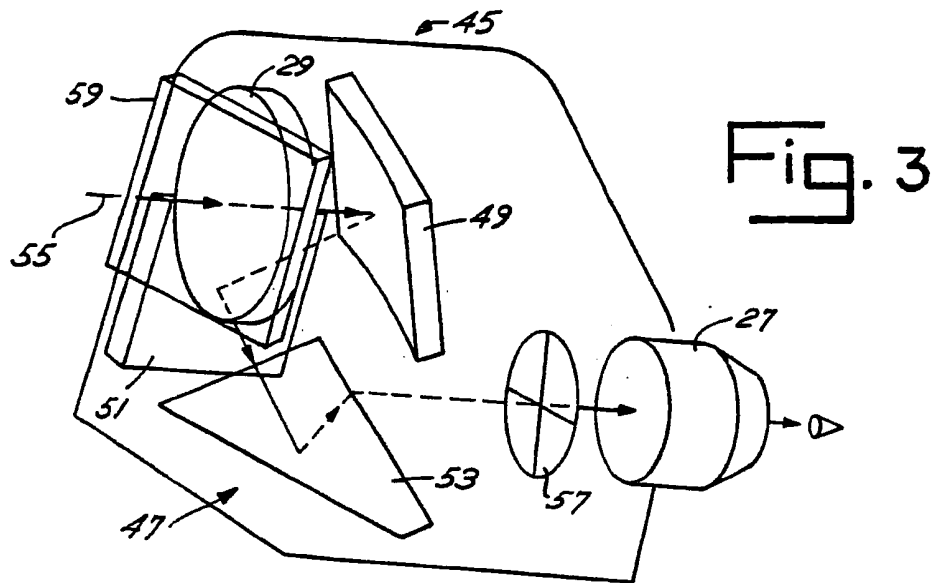


Fig. 6

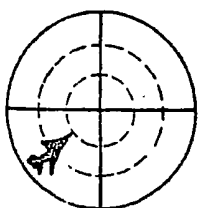


Fig. 7

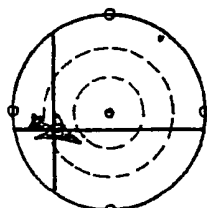
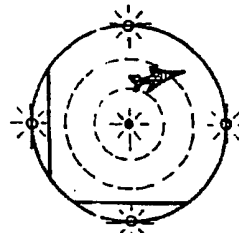


Fig. 8





Europäisches Patentamt
European Patent Office
Office européen des brevets



Publication number: **0 276 099 A3**

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84 Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

86 Date of deferred publication of the search report:
03.07.91 Bulletin 91/27

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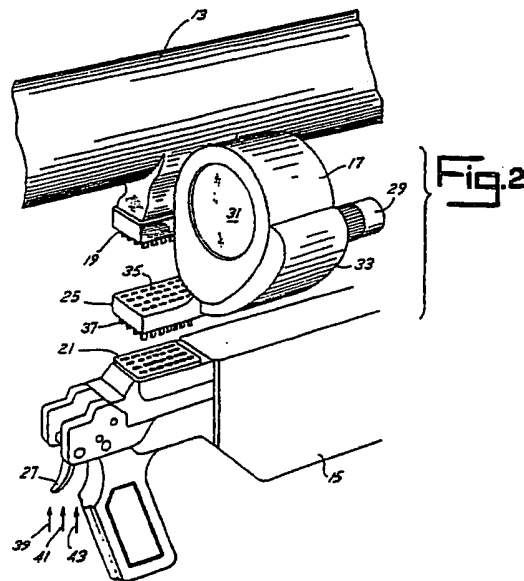


Fig. 2